

FISHERY DATA SERIES NO. 90-38

HARVEST ESTIMATES FOR SELECTED
ENHANCED ROADSIDE SPORT FISHERIES
NEAR JUNEAU, ALASKA DURING 1989¹

By

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September 1990

¹ This investigation was financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-5, Job Numbers S-1-1A and S-1-1B.

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	ii
LIST OF APPENDICES	iii
ABSTRACT	1
INTRODUCTION	2
METHODS	5
Study Design	5
Data Collection	7
Harvest Estimate Data Analysis	7
Contributions of Coded-Wire Tagged Stocks	11
RESULTS	14
Montana Creek Steelhead Fishery	14
Chinook Salmon Fisheries	14
Coho Salmon Fisheries	17
DISCUSSION	21
Montana Creek Steelhead Fishery	21
Chinook Salmon Fisheries	21
Coho Salmon Fisheries	23
CONCLUSIONS AND RECOMMENDATIONS	23
ACKNOWLEDGEMENTS	26
LITERATURE CITED	26
APPENDIX A	28

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Summary of hatchery reared chinook salmon, coho salmon, and steelhead smolts released on the Juneau roadside, 1986-1989	3
2. Summary of sampling effort by area for Juneau roadside enhancement fisheries sampled during 1989	6
3. Effort and harvest statistics for the Montana Creek steelhead enhancement surveys by biweekly period and area during 1989	15
4. Effort and harvest statistics for the Juneau roadside chinook salmon enhancement surveys by biweekly period and area during 1989	16
5. Estimates of hatchery produced chinook salmon contributed to Juneau roadside sport fisheries from 19 June to 5 November 1989	18
6. Effort and harvest statistics for the Juneau roadside coho salmon enhancement surveys by biweekly period and area during 1989	19
7. Recovery and contribution estimates for hatchery coho salmon taken on the Juneau roadside during 1989	20
8. Summary of contributions of hatchery chinook salmon for 1986 releases by tag lot on the Juneau roadside to sport and commercial fisheries, 1988-1989	22
9. Summary of contributions of hatchery coho salmon releases by tag lot on the Juneau roadside to local sport fisheries, 1986-1989	24

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Sport fishing areas along the Juneau road system surveyed during 1989, along with the terminal harvest area opened to increased bag limits for chinook salmon	4
2. Contributions to sport fisheries per 1,000 smolts released for 1987 and 1988 releases of coho salmon on the Juneau roadside	25

LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
A1. Descriptions of roadside fisheries surveyed in 1989	29
A2. Effort and harvest statistics for the Montana Creek steelhead enhancement surveys by biweekly period and area during 1989	31
A3. Effort and harvest statistics for the chinook salmon enhancement surveys by biweekly period and area during 1989	32
A4. Effort and harvest statistics for the coho salmon enhancement surveys by biweek and area during 1989	36
A5. Estimates of hatchery produced coho salmon contributed to Juneau roadside sport fisheries from 19 June to 5 November 1989	40

ABSTRACT

Angler effort and harvest was estimated for selected Juneau roadside sport fisheries enhanced by local hatchery stocks during 1989. The contributions of hatchery chinook salmon *Oncorhynchus tshawytscha* and coho salmon *Oncorhynchus kisutch* to the fisheries by coded-wire tag lot were also estimated.

Steelhead *Oncorhynchus mykiss* enhancement efforts in Montana Creek failed to generate a substantial sport fishery during 1989 as no harvested steelhead were observed during random creel surveys conducted from 10 April to 4 June.

Chinook salmon enhancement efforts were more successful as harvest by roadside anglers totaled 119 large chinook salmon, at least 28 inches or 71 centimeters in total length (standard error = 66). Additionally, 227 small chinook salmon, less than 28 inches in length, were also harvested (standard error = 111). The most successful release site for chinook salmon was at Fish Creek where anglers caught 0.22 chinook salmon per angler-hour of effort during the period from 19 June to 27 August. The contribution of specific hatchery releases of chinook salmon was estimated to be a total of 284 fish (standard error = 76).

Substantial fisheries were also generated by Juneau roadside releases of coho salmon as an estimated 741 large coho salmon, at least 16 inches or 41 centimeters in total length, were harvested (standard error = 132). Harvest of jack salmon, less than 16 inches in length, was 2,109 (standard error = 364). Approximately, 2,606 (91 percent) of the total coho salmon harvested were contributed by specific hatchery releases (standard error = 370).

Additional harvests of hatchery chinook and coho salmon from roadside releases were also taken by Juneau boat anglers, and some of the hatchery releases were evaluated by examining contributions to both roadside and boat sport fisheries.

KEY WORDS: Creel survey, angler effort and harvest, sport fishery, hatchery, enhancement, coded-wire tag, chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, steelhead, *Oncorhynchus mykiss*, Juneau, southeast Alaska.

INTRODUCTION

The marine and fresh waters of southeast Alaska support important commercial, sport, and subsistence fisheries for a variety of salmonid, bottomfish, and shellfish species. Boat sport fisheries in saltwater for chinook *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* are the largest and most important sport fisheries in the region, however, freshwater and saltwater fisheries accessed from the roadside are also significant. In 1988, about 8% (6,671 angler days) of the total freshwater sport fishery effort in southeast Alaska occurred on the Juneau roadside (Mills 1989), even though only a tiny fraction of the total freshwater fishing opportunities in southeast Alaska occurs in this area. Additionally, about 40% (18,458 angler days) of the total saltwater shoreline effort expended in southeast Alaska occurred on the Juneau roadside.

To provide better opportunities for anglers on the Juneau roadside, sport fishery enhancement projects funded through the Dingell-Johnson Expansion Program have been initiated. Chinook and coho salmon and steelhead *O. mykiss* enhancement efforts on the Juneau roadside during the past few years have been extensive and these programs are expected to continue (Table 1). The hatchery release sites used are distributed along the Juneau roadside (Figure 1). Evaluations of angler effort and success at enhancement sites are necessary to determine the success of hatchery releases in improving local roadside fisheries for chinook and coho salmon and steelhead. Besides returning to the terminal harvest areas, some of these fish are also harvested in the Juneau marine boat sport fishery. To provide for additional harvest of returning hatchery chinook salmon by both roadside and boat sport anglers, a terminal harvest area (Figure 1) with increased chinook salmon bag limits was formed by emergency regulation in 1989.

Release sites and rearing and imprinting strategies for hatchery chinook and coho salmon may vary greatly in their effectiveness in contributing fish to the sport harvest. Once the sport fishery contributions from different releases are known, resources may be directed to developing those brood stocks, imprinting and rearing strategies, and release sites that are most cost effective in enhancing sport fisheries. This report presents harvest estimates for selected enhanced roadside sport fisheries and also evaluates selected releases of hatchery fish on the Juneau roadside as to their effectiveness in contributing to both marine and roadside sport fisheries in the local area.

During 1989, the bag limit for steelhead greater than 16 inches in length was 1 per day and in possession, although an additional fish could be taken if at least one fish had a clipped adipose fin. The bag limit for coho salmon 16 inches or more in length in saltwater areas was 6 fish per day and 12 in possession, while freshwater anglers were limited to 2 fish per day and in possession. An additional 10 coho salmon less than 16 inches in length could be taken in both fresh and saltwater.

From 10 June to 30 September, Juneau roadside streams were opened to the harvest of chinook salmon by emergency order. A terminal harvest area in saltwater was also opened to the taking of small (less than 28 inches in total length) chinook salmon from June 10 through July 31 and, since chinook salmon continued to be available, from 14 August to 30 September (Figure 1). The terminal area encompassed Gastineau Channel north and west of a line at the latitude of Dupont dock, and Fritz Cove and Auke Bay east of a line from False Outer Point to Indian Point. This area was opened to provide for harvest of mature small chinook salmon by both shoreline and boat anglers. The bag and possession limit for

Table 1. Summary of hatchery reared chinook salmon, coho salmon, and steelhead smolts released on the Juneau roadside, 1986-1989.^a

Site	Release Strategy ^b	1986	1987	1988	1989
		No. ^c (tag lot)	No. ^c (tag lot)	No. ^c (tag lot)	No. ^c (tag lot)
<u>CHINOOK SALMON</u>					
Montana Creek	DIR	28,335 (4-26-2)	30,703 (4-27-45)	52,000 (4-26-12)	10,000 (4-31-34) 23,000 (4-31-58)
Fish Creek	DIR	30,620 (4-26-5)	31,479 (4-27-42)	0	0
	IMP	29,652 (4-26-7)	31,205 (4-27-44)	74,000 (4-30-01)	67,000 (4-31-60)
Auke Creek mouth	DIR	26,896 (4-26-8)	50,522 (4-27-43)	0	0
	RET	29,003 (4-26-1)	15,038 (4-27-50)	46,000 (4-29-62)	0
	IMP	29,737 (4-26-3)	24,972 (4-27-46)	46,000 (4-29-61)	117,000 (4-32-01)
Sheep Creek mouth	IMP	30,280 (4-26-6)	31,112 (4-27-48)	31,556 (4-30-02)	43,000 (4-31-61) 77,000 (4-31-62)
Gastineau Hatchery	IMP	0	0	0	11,000 (4-31-36)
Totals		204,523	215,031	249,556	348,000
<u>COHO SALMON</u>					
Salmon Creek	IMP	20,422 (4-23-61)	101,000 (4-27-28)	0	0
Fish Creek	IMP	0	53,000 (4-27-29)	50,000 (4-29-48)	42,000 (4-31-53)
Sheep Creek	RET	0	39,442 (4-28-20)	100,000 (4-29-47)	44,940 (4-31-54)
Mendenhall Ponds	DIR	0	53,000 (4-27-30)	50,000 (4-29-49)	37,000 (4-31-55)
Gastineau Hatchery	IMP	0	0	49,659 (4-30-15)	36,866 (4-32-31)
Auke Rec. Area	IMP	0	0	18,896 (4-30-14)	0
Totals		20,422	246,442	268,555	160,806
<u>STEELHEAD</u> <u>SOURCE^d</u>					
Montana Creek	Crys. L.	2,440 (4-25-10)	0	0	0
	Snett.	0	2,353 (4-25-51)	0	0
	Klawock	0	28,560 (Ad-clipped only)	0	0
Totals		2,440	30,913	0	0

^a This table does not include releases of coho salmon at Twin Lakes.

^b DIR = Direct release
RET = Retained and fed
IMP = Retained, fed, and imprinted

^c No. = Number released

^d Crys. L = Crystal Lake Hatchery, Falls Creek stock
Snett = Snettisham Hatchery, Peterson Creek stock
Klawock = Klawock Hatchery, Klawock River stock

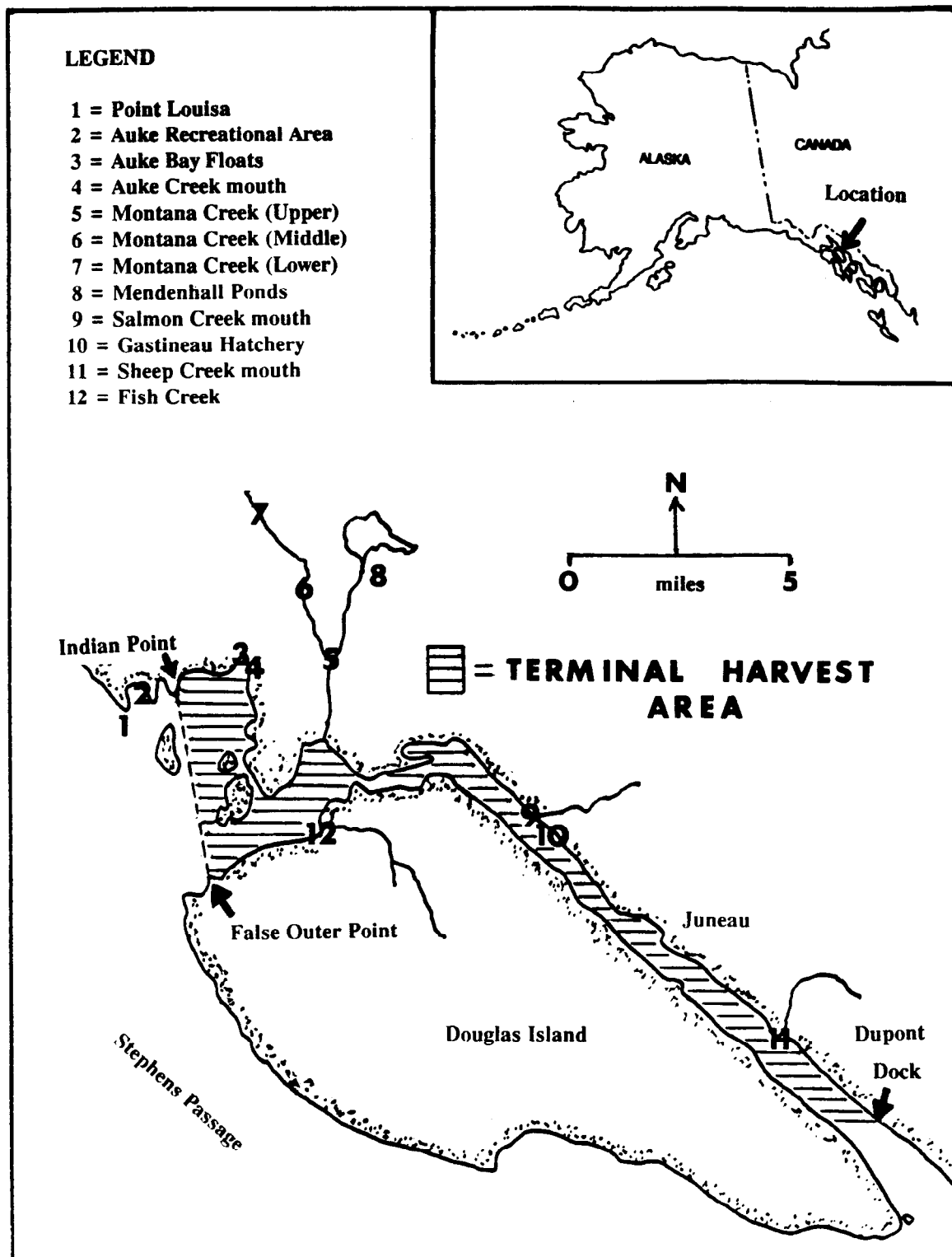


Figure 1. Sport fishing areas along the Juneau road system surveyed during 1989, along with the terminal harvest area opened to increased bag limits for chinook salmon.

chinook salmon in the Juneau roadside streams and in the terminal harvest area was 2 large (28 inches or greater in total length) fish and 2 small fish.

The specific objectives for the 1989 Juneau roadside harvest surveys were:

1. To estimate the total angler effort and harvest of hatchery produced chinook salmon by coded-wire tag lot in terminal harvest areas at the mouths of Auke and Sheep creeks and in Montana and Fish creeks from 19 June to 27 August 1989.
2. To estimate the total angler effort and harvest of hatchery produced coho salmon by coded-wire tag lot in terminal harvest areas at Sheep Creek, Fish Creek, Gastineau Hatchery, and Mendenhall Ponds from 28 August to 5 November 1989.
3. To estimate the total angler effort and harvest of hatchery produced steelhead by coded-wire tag lot in Montana Creek from 10 April to 4 June 1989.

METHODS

Study Design

A roving type of creel survey (Neuhold and Lu 1957) was used to estimate angler effort and harvest for the Juneau roadside fisheries. The study areas surveyed were distributed along the Juneau roadside in close proximity to hatchery release sites (Figure 1). Sampling effort at the sites was limited to periods during which hatchery fish were expected to be available at the sites (Table 2). Site descriptions for each of the locations surveyed can be found in Appendix A1. During the chinook salmon surveys, the Auke Bay Floats site was sampled, as this area is located very close to the Auke Creek mouth release site. Similarly, during the coho salmon surveys, the Point Louisa, Auke Bay Floats, and Auke Creek mouth sites were surveyed because coho salmon released at the Auke Recreational Area might stray to these locations and be taken. Salmon Creek mouth was surveyed during the coho salmon surveys because fish released at the nearby Gastineau Hatchery might also stray to this area.

The creel survey was conducted from 10 April through 5 November 1989. The season was divided into biweekly periods which began on Mondays and ended on Sundays. Biweekly periods between April 10 and 4 June were considered steelhead surveys, periods between 19 June and 27 August were considered chinook salmon surveys, and periods between 28 August and 5 November were considered coho salmon surveys. No surveys were conducted during the biweekly period from 5 June through 18 June.

Within each biweekly period, all days were classified as either weekdays or weekend/holidays (all Saturdays, Sundays, and the dates of 29 May, 4 July, 5 September, and 9 October). Sampling was split approximately 50% to weekdays and 50% to weekend/holidays to approximate the relative amount of angling effort occurring at these times. No more than two sampling periods were chosen for sampling within a given day to limit daily time worked to about 8 to 10 hours. Two consecutive weekdays were also chosen for non-sampling to assure two days off for staff. No weekend/holidays were sampled during 5 and 6 August, as staff were needed to sample the Juneau Golden North Salmon Derby.

Table 2. Summary of sampling effort by area for Juneau roadside enhancement fisheries sampled during 1989.

XXX = Enhancement Site Survey		--- = Not surveyed	
	Steelhead	Chinook Salmon	Coho Salmon
	10 April - 4 June	19 June - 27 Aug.	28 Aug. - 5 Nov.
<u>Freshwater:</u>			
Montana Creek			
Lower	XXX	XXX	---
Middle	XXX	XXX	---
Upper	XXX	XXX	---
Fish Creek	---	XXX	XXX
Mendenhall Ponds	---	---	XXX
<u>Saltwater:</u>			
Point Louisa	---	---	XXX ^a
Auke Recreational Area	---	---	XXX ^a
Auke Bay Floats	---	XXX	XXX ^a
Auke Creek Mouth	---	XXX	XXX ^a
Gastineau Hatchery	---	---	XXX
Salmon Creek	---	---	XXX ^a
Sheep Creek	---	XXX	XXX

^a These sites not surveyed during the biweekly period from 23 October to 5 November.

The sampling day began at 0600 hours or at 1 hour after the beginning of civil twilight, whichever was later. The sampling day ended at the end of civil twilight but no later than 2330 hours. Length of the sampling day was rounded to the nearest hour.

All sites were sampled during a given sampling occasion for which the starting time was randomly selected from hours of the sampling day. The starting location for each sampling occasion was also chosen randomly, but the remainder of the route was selected so that mileage was minimized. The duration of surveys varied in length depending on season, weather, and route, but typically took less than the time allotted in the schedule. For this reason, starting times for the surveys were randomly adjusted by the creel technician after they estimated survey duration.

Data Collection

Individual anglers were asked the number of hours fished, whether the trip was complete or incomplete, and the number of each fish species that were taken and released. Chinook salmon less than 28 inches (71 cm) in total length were categorized as small chinook salmon. Chinook salmon 28 inches or more in length were categorized as large chinook salmon. Similarly, coho salmon less than 16 inches (41 cm) in total length were called jack coho salmon, while those 16 inches and greater in length were called large coho salmon.

An instantaneous count of the number of anglers fishing in an area was also recorded. For each sample, counts were conducted either before or after interviews as determined on a random basis. Harvested chinook and coho salmon and steelhead were also checked for missing adipose fins.

Harvest Estimate Data Analysis

Angler effort and harvest, and associated variances and standard errors were estimated for each site and fishery for the creel survey using the following procedures. A stratified random estimator was used to estimate effort in angler-hours. As noted above, each stratum was defined by the unique combinations of biweekly sampling period, and type of day (i.e., weekday or weekend-holiday). The average angler count within each sampling stratum was multiplied by the total number of available sampling hours for each stratum. The effort estimates and the associated variance estimates were obtained according to the following equations (essentially following the approach of Von Geldern and Tomlinson 1973):

$$\begin{aligned}\hat{E}_h &= \text{estimated angler-hours expended in stratum } h \text{ of each fishery;} \\ &= R_h \bar{x}_h; \end{aligned} \tag{1}$$

h = subscript denoting the stratum;

R_h = total number of hours (available for sampling) in stratum h ;

$$\begin{aligned}\bar{x}_h &= \text{mean number of anglers fishing over all samples in stratum } h; \\ &= \frac{\sum_{i=1}^{d_h} x_{hi}}{d_h}; \end{aligned} \tag{2}$$

i = subscript denoting count sample within stratum h ;
 d_h = number of samples (i.e., counts) completed in stratum h ;
 x_{hi} = number of anglers counted in sample i for stratum h ;
 $\hat{V}_h[\hat{E}_h]$ = the variance estimate for the estimate of \hat{E}_h ;

$$= R_h^2 \left(\frac{s_h^2}{d_h} \right); \quad (3)$$

$$s_h^2 = \frac{\sum_{i=1}^{d_h} (x_{hi} - \bar{x}_h)^2}{d_h - 1} . \quad (4)$$

Angler catch and harvest rates along with their variances were estimated from interview data using a stratified multi-stage random estimator, according to the following equations:

\hat{T}_h = estimated total catch or harvest per unit effort for stratum h of each fishery;

$$= \frac{\sum_{j=1}^{n_h} \left(\sum_{k=1}^{o_j} c_{hjk} \right)}{\sum_{j=1}^{n_h} \left(\sum_{k=1}^{o_j} e_{hjk} \right)}; \quad (5)$$

j, k = subscripts denoting the individual interview sample and the angler interviewed, respectively, within stratum h ;
 n_h = number of interview samples collected within stratum h ;
 o_j = number of anglers interviewed within sample j ;
 c_{hjk} = catch or harvest of angler k interviewed within sample j in stratum h ;
 e_{hjk} = effort expended by angler k interviewed within sample j in stratum h ;
 $\hat{V}_h[\hat{T}_h]$ = estimated variance of the catch per unit effort (CPUE) or harvest per unit effort (HPUE) for stratum h , obtained by the approximation formula for the variance of the ratio of random variables (Jessen 1978, equation 5.8, page 128, omitting the finite population correction factor);

$$\approx \left\{ \frac{\bar{c}_h}{\bar{e}_h} \right\}^2 \left\{ \frac{s_{(c)h}^2}{\bar{c}_h^2} + \frac{s_{(e)h}^2}{\bar{e}_h^2} - \frac{2 \text{COV}_{(c,e)h}}{\bar{c}_h \bar{e}_h} \right\}; \quad (6)$$

$$\begin{aligned}\bar{\bar{c}}_h &= \text{mean of mean catch or harvest per angler for stratum } h; \\ &= \frac{\sum_{j=1}^{n_h} \bar{c}_{hj}}{n_h};\end{aligned}\quad (7)$$

$$\begin{aligned}\bar{\bar{e}}_h &= \text{mean of mean effort per angler for stratum } h; \\ &= \frac{\sum_{j=1}^{n_h} \bar{e}_{hj}}{n_h};\end{aligned}\quad (8)$$

$$\begin{aligned}\bar{c}_{hj} &= \text{mean catch or harvest per angler for sample } j \text{ in stratum } h; \\ &= \frac{\sum_{k=1}^{o_j} c_{hjk}}{o_j};\end{aligned}\quad (9)$$

$$\begin{aligned}\bar{e}_{hj} &= \text{mean effort per angler for sample } j \text{ in stratum } h; \\ &= \frac{\sum_{k=1}^{o_j} e_{hjk}}{o_j};\end{aligned}\quad (10)$$

$$s_{(c)h}^2 = \text{variance estimate associated with estimating the catch or harvest component of CPUE or HPUE in stratum } h;$$

$$= \left\{ \left[1 - \frac{n_h}{N_h} \right] \left[\frac{s_{(c)bh}^2}{n_h} \right] \right\} + \left\{ \left[\frac{n_h}{N_h} \right] \left[\frac{\sum_{j=1}^{n_h} \frac{s_{(c)whj}^2}{o_j}}{n_h^2} \right] \right\}; \quad (11)$$

$$N_h = \text{total possible number of interview samples within stratum } h;$$

$$s_{(c)bh}^2 = \text{the between sample variance component for the variance estimate of catch or harvest in stratum } h;$$

$$= \frac{\sum_{j=1}^{n_h} (\bar{c}_{hj} - \bar{\bar{c}}_h)^2}{n_h - 1}; \quad (12)$$

$$s_{(c)whj}^2 = \text{the within sample variance component for the variance estimate of catch or harvest in sample } j \text{ in stratum } h;$$

$$= \frac{\sum_{k=1}^{o_j} (c_{hjk} - \bar{c}_{hj})^2}{o_j - 1}; \quad (13)$$

$$s_{(e)h}^2 = \text{variance estimate associated with estimating the effort component of CPUE or HPUE in stratum } h, \text{ calculated by substituting the corresponding effort statistics into equations (11) - (13);}$$

$COV_{(c,e)h}$ = covariance estimate between the catch (or harvest) and effort components of the CPUE or HPUE in stratum h ;

$$= \left\{ \left[1 - \frac{n_h}{N_h} \right] \left[\frac{COV_{(c,e)bh}}{n_h} \right] \right\} + \left\{ \left[\frac{n_h}{N_h} \right] \left[\frac{\sum_{j=1}^{n_h} \frac{COV_{(c,e)whj}}{O_j}}{n_h^2} \right] \right\}; \quad (14)$$

$COV_{(c,e)bh}$ = the between sample covariance component between catch (or harvest) and effort in stratum h ;

$$= \frac{\sum_{j=1}^{n_h} [(\bar{c}_{hj} - \bar{\bar{c}}_h)(\bar{e}_{hj} - \bar{\bar{e}}_h)]}{n_h - 1}; \quad (15)$$

$COV_{(c,e)whj}$ = the within sample covariance component for CPUE or HPUE in sample j in stratum h ;

$$= \frac{\sum_{k=1}^{O_j} [(c_{hjk} - \bar{c}_{hj})(e_{hjk} - \bar{e}_{hj})]}{O_j - 1}. \quad (16)$$

Estimates of angler catch or harvest and their variances were obtained by combining the estimated stratum estimates of effort and catch (or harvest) rates, as follows:

$$\hat{C}_h = \hat{E}_h \hat{T}_h; \quad (17)$$

$\hat{V}_h[\hat{C}_h]$ = estimated variance of \hat{C}_h in stratum h , assuming independence of the estimates of effort and CPUE or HPUE, obtained by using the formula proposed by Goodman (1960);

$$= \hat{E}_h^2 \hat{V}_h[\hat{T}_h] + \hat{T}_h^2 \hat{V}_h[\hat{E}_h] - \hat{V}_h[\hat{E}_h] \hat{V}_h[\hat{T}_h]. \quad (18)$$

Total angler effort, catch, or harvest across all strata (or select combinations of strata) were obtained by the following equations:

\hat{Y} = total estimated effort, catch, or harvest, where Y equals the parameter of interest (e.g., E , C , or H for effort, catch, or harvest);

$$= \sum_{h=1}^q \hat{Y}_h; \quad (19)$$

q = number of strata to be combined;

\hat{Y}_h = estimate for the parameter of interest in stratum h ;

$\hat{V}[\hat{Y}]$ = estimated variance of \hat{Y} , assuming independence of the stratum estimates;

$$= \sum_{h=1}^g \hat{V}_h[\hat{Y}_h]; \quad (20)$$

$\hat{V}_h[\hat{Y}_h]$ = variance estimate for the parameter of interest in stratum h .

Standard errors for stratum estimates and across stratum estimates were obtained by taking the square root of each appropriate variance estimate.

Totals across fisheries were obtained in a similar manner to totals across strata.

The assumptions necessary for effort, catch, and harvest estimates to be unbiased include the following:

1. anglers accurately report their hours of fishing effort and the number by species of fish released;
2. no significant fishing effort occurred between the evening civil twilight and 0600 hours (or morning civil twilight);
3. incomplete trip angler interviews provide an unbiased estimate of completed-trip HPUE and CPUE; and
4. anglers are interviewed in proportion to their abundance in each sampling period, and interviewed anglers are representative of the total angler population.

Contributions of Coded-Wire Tagged Stocks

Chinook and coho salmon and steelhead sampled that had missing adipose fins were measured to the nearest 5 mm (tip of snout to fork of tail) and their heads were retained. A locking plastic strap with a unique number was inserted through the jaw. Heads and coded-wire tag (CWT) recovery data were sent to the Alaska Department of Fish and Game CWT Processing Laboratory in Juneau for tag removal and decoding.

Heads were classified as "random" (randomly sampled during regularly scheduled creel sampling periods) or "select" (voluntarily provided by unsampled anglers). Only random recoveries were used to estimate CWT contributions.

Hatchery contributions, associated variances, and standard errors were estimated for the creel survey using the following procedures. These procedures essentially follow the approach outlined by Clark and Bernard (1987) as modified by Conrad and Larson (1987). Conrad and Larson's modification of Clark and Bernard's procedures entail the incorporation of the variance due to estimating the overall harvest (both wild and hatchery stocks). The notation used in the following equations essentially follows that used by Clark and Bernard (1987), with additional subscripts used to denote individual stratum values.

The first step involved estimating the contribution to each sampling stratum in the fishery of each particular tag code (using equation [10] from Clark and Bernard 1987):

$$\begin{aligned}\hat{n}_{1,h} &= \text{estimated number of salmon from a hatchery release identified} \\ &\quad \text{by the unique tag code } A, \text{ harvested in stratum } h; \\ &= \left(\frac{\hat{N}_h}{n_{2h}} \right) \left(\frac{a_{1h}}{a_{2h}} \right) \left(\frac{m_{1h}}{m_{2h}} \right) \left(\frac{m_{c_{Ah}}}{\theta_A} \right); \quad (21)\end{aligned}$$

where:

- h = subscript denoting sampling stratum for both the harvest and contribution sampling programs;
- A = subscript denoting any unique tag code associated with a hatchery release;
- \hat{N}_h = estimated total harvest of salmon (one particular species only) for stratum h ;
- n_{2h} = number of salmon (one particular species only) inspected for missing adipose fins from the sampled harvest in stratum h ;
- a_{1h} = number of salmon with a missing adipose fin which are counted and marked with a head strap from stratum h ;
- a_{2h} = number of salmon heads previously marked with a head strap which arrive at the tag lab, from fish originally sampled from stratum h ;
- m_{1h} = number of coded-wire tags which are detected in the salmon heads at the tag lab, from those salmon sampled in stratum h ;
- m_{2h} = number of coded-wire tags which are removed from the salmon heads and decoded, from those salmon sampled in stratum h ;
- $m_{c_{Ah}}$ = number of coded-wire tags dissected out of the salmon heads and decoded as the unique tag code A , originally sampled from stratum h ; and
- θ_A = proportion of a particular hatchery release which contains a coded-wire tag of the unique tag code A .

The variance of the above estimate was obtained following the approach proposed by Conrad and Larson (1987), in which the terms \hat{N}_h and $m_{c_{Ah}}$ were treated as random variates, and all other terms in equation (21) were treated as constants (accordingly the approach first proposed by Goodman 1960 is used for the second major term of equation (22)):

$$S_{\hat{n}_{1,h}}^2 = \left\{ \left(\frac{1}{n_{2h}} \right) \left(\frac{a_{1h}}{a_{2h}} \right) \left(\frac{m_{1h}}{m_{2h}} \right) \left(\frac{1}{\theta_A} \right) \right\}^2$$

$$\{ \hat{N}_h^2 V[m_{c,h}] + m_{c,h}^2 \hat{V}[\hat{N}_h] - \hat{V}[\hat{N}_h] V[m_{c,h}] \}; \quad (22)$$

where:

$\hat{V}[\hat{N}_h]$ = estimated variance of overall harvest estimate for stratum h , obtained from harvest sampling program (see equation (18), above);

$V[m_{c,h}]$ = variance of "random variate" $m_{c,h}$, approximated by the approach used by Clark and Bernard (1987; equation [12]);

$$\approx \frac{n_{2h}(n_{2h}-1)a_{2h}(a_{2h}-1)m_{2h}(m_{2h}-1)\hat{n}_{1,h}(\hat{n}_{1,h}-1)\theta_A^2}{\hat{N}_h(\hat{N}_h-1)a_{1h}(a_{1h}-1)m_{1h}(m_{1h}-1)}$$

$$+ \frac{n_{2h}a_{2h}m_{2h}\hat{n}_{1,h}\theta_A}{\hat{N}_ha_{1h}m_{1h}} - \left(\frac{n_{2h}a_{2h}m_{2h}\hat{n}_{1,h}\theta_A}{\hat{N}_ha_{1h}m_{1h}} \right)^2. \quad (23)$$

The final step in calculating the variance of $\hat{n}_{1,h}$ was to perform the following bias correction (Clark and Bernard 1987; equation [15]):

$$\hat{V}[\hat{n}_{1,h}] = \left\{ \frac{(\hat{N}_h-1)n_{2h}(a_{1h}-1)a_{2h}(m_{1h}-1)m_{2h}}{\hat{N}_h(n_{2h}-1)a_{1h}(a_{2h}-1)m_{1h}(m_{2h}-1)} \right\} \{ S_{\hat{n}_{1,h}}^2 \}. \quad (24)$$

In order to obtain the estimated contribution to the fishery across combinations of different tag codes and/or different strata, the following equations were used (as outlined by Clark and Bernard 1987; equation [16]):

\hat{TC}_{n_1} = estimated total contribution of a combination of tag codes and sampling strata;

$$= \sum_{h=1}^L \sum_{A=1}^t \hat{n}_{1,h}; \quad (25)$$

where:

L = number of stratum to be combined; and

t = number of tag codes to be combined.

The variance of this combined estimate was obtained by (Clark and Bernard 1987; equation (17)):

$$\hat{V}[\hat{TC}_{n_1}] = \left\{ \sum_{h=1}^L \sum_{A=1}^t \hat{V}[\hat{n}_{1,h}] \right\} + \left\{ 2 \left(\sum_{h=1}^L \sum_{A=1}^t \sum_{B>A}^t c \hat{Cov}[\hat{n}_{1,h}, \hat{n}_{1,B}] \right) \right\}; \quad (26)$$

where:

$$\begin{aligned} \text{cov}[\hat{n}_{1,h}, \hat{n}_{1,h}] &= \text{estimated covariance between the estimated contributions} \\ &\text{for unique tag code A and B within stratum h (note we} \\ &\text{assume that sampling is conducted independently between} \\ &\text{strata, therefore covariances are only needed for the} \\ &\text{within stratum values), obtained as outlined in Clark} \\ &\text{and Bernard (1987; equation [22]);} \\ &= \hat{n}_{1,h} \hat{n}_{1,h} \left\{ \frac{\hat{N}_h(n_{2h}-1)a_{1h}(a_{2h}-1)m_{1h}(m_{2h}-1)}{(\hat{N}_h-1)n_{2h}(a_{1h}-1)a_{2h}(m_{1h}-1)m_{2h}} - 1 \right\}. \end{aligned} \quad (27)$$

Since our estimates of contributions are estimates of totals, then standard errors (SE's) are obtained as the square root of the appropriate variance.

RESULTS

Montana Creek Steelhead Fishery

Montana Creek was surveyed at three sites during the period from 10 April to 4 June (Table 3 and Appendix A2). Steelhead were present in upper Montana Creek by 6 May, as one angler was observed with a fish at this time and another steelhead was observed in a pool. Angler effort was very limited at all three sites and totaled 263 angler-hours (SE = 85). Effort peaked during the period from 8 May to 21 May. No steelhead were observed to have been harvested during the creel surveys, but 2 "select" heads were supplied by anglers. Neither of these two heads contained coded-wire tags. An estimated 16 (SE = 11) steelhead were released by anglers in upper Montana Creek.

Chinook Salmon Fisheries

During the period from 19 June to 27 August, an estimated 16,990 angler-hours (SE = 1,825) were expended at the surveyed chinook salmon enhancement sites (Table 4 and Appendix A3). Much of this effort was not directed at chinook salmon, however, as pink *O. gorbuscha* and chum salmon *O. keta* and Dolly Varden *Salvelinus malma* are more traditional targets of roadside anglers during this time. During the chinook salmon surveys, 65 large chinook salmon (SE = 40) and an additional 200 small chinook salmon (SE = 97) were taken. Additional chinook salmon harvest occurred during the coho salmon surveys, when an additional 54 large chinook salmon (SE = 53) and 27 small chinook salmon (SE = 15) were taken (Appendix A4). No large chinook salmon were released, but 193 small chinook salmon (SE = 53) were released.

Chinook salmon became available at the sites in early July and were available until early September. Peak catches occurred in early August as a total of 326 chinook salmon (SE = 109) were caught during the biweekly period from 31 July to 13 August. The most successful terminal fishery was at Fish Creek, where anglers caught 0.22 chinook salmon per angler-hour during the period from 19 June to 27 August. Chinook salmon were also harvested at Auke Creek mouth and the Auke Bay docks. No sport caught chinook salmon were sampled at Sheep Creek or Montana Creek.

Table 3. Effort and harvest statistics for the Montana Creek steelhead enhancement surveys by biweekly period and area during 1989.

	Biweekly Period				
	10 April 23 April	24 April 07 May	08 May 21 May	22 May 04 June	Total
<u>Effort (Angler-Hours)</u>					
Montana Creek - Upper	0	32	59	0	91
Middle	0	27	0	0	27
Lower	20	48	53	24	145
Total	20	107	112	24	263
Standard Error	12	52	62	23	85

<u>Steelhead Released^a</u>					
Montana Creek - Upper	0	0	16	0	16
Middle	0	0	0	0	0
Lower	0	0	0	0	0
Total	0	0	16	0	16
Standard Error	--	--	11	--	11

^a There were no harvested steelhead observed during random creel surveys although at least 2 steelhead were harvested by sport anglers (as evidenced by voluntary head returns).

Table 4. Effort and harvest statistics for the Juneau roadside chinook salmon enhancement surveys by biweekly period and area during 1989.

	Biweekly Period					
	19 June 02 July	03 July 16 July	17 July 30 July	31 July 13 Aug.	14 Aug. 27 Aug.	Total
<u>Effort (Angler-Hours)</u>						
Auke Bay Floats	1,830	791	235	384	1,042	4,282
Auke Creek Mouth	170	142	336	0	173	821
Montana Creek ^a	318	355	330	235	171	1,409
Sheep Creek	918	2,553	2,736	2,048	456	8,711
Fish Creek	210	272	187	672	426	1,767
Total	3,446	4,113	3,824	3,339	2,268	16,990
SE	1,400	575	621	668	453	1,825

<u>Large Chinook Salmon (>28") Kept^b</u>						
Auke Bay Floats	0	0	0	0	0	0
Auke Creek Mouth	0	0	0	0	0	0
Montana Creek ^a	0	0	0	0	0	0
Sheep Creek	0	0	0	0	0	0
Fish Creek	0	0	0	57	8	65
Total	0	0	0	57	8	65
SE	--	--	--	40	5	40

<u>Small Chinook Salmon (<28") Kept^b</u>						
Auke Bay Floats	0	16	0	0	0	16
Auke Creek Mouth	0	0	13	0	0	13
Montana Creek ^a	0	0	0	0	0	0
Sheep Creek	0	0	0	0	0	0
Fish Creek	0	0	3	152	16	171
Total	0	16	16	152	16	200
SE	--	12	18	94	13	97

<u>Small Chinook Salmon (<28") Released</u>						
Auke Bay Floats	0	0	0	0	36	36
Auke Creek Mouth	0	0	0	0	0	0
Montana Creek ^a	0	0	0	0	0	0
Sheep Creek	0	0	0	0	0	0
Fish Creek	0	0	0	117	40	157
Total	0	0	0	117	76	193
SE	--	--	--	37	38	53

^a Montana Creek includes the lower, middle, and upper sites.

^b Additional harvest of 54 large chinook salmon and 27 small chinook salmon occurred during subsequent roadside coho salmon surveys.

A total of 7 large and 16 small chinook salmon were sampled for missing adipose fins, and contribution estimates by tag lot were calculated for each sport fishery (Table 5). At Fish Creek, one of the four tags decoded was from a fish released at Sheep Creek although the remainder were from Fish Creek releases. One of the chinook salmon captured at Auke Bay docks and one taken at Auke Creek mouth were immature fish released in 1989 at Montana Creek and Gastineau Hatchery. All of the other chinook salmon taken at the sampled roadside sites were mature. All of the age 3-ocean chinook salmon sampled from the roadside fisheries were greater than 28 inches (71 cm) in length, however, only 1 of 3 sampled age 2-ocean fish was longer than 28 inches.

Coho Salmon Fisheries

Hatchery releases of sea-run coho salmon on the Juneau roadside during 1988 generated substantial sport fisheries and harvests during 1989 (Table 6 and Appendix A4). An estimated total of 5,239 angler-hours (SE = 347) were expended at the 9 sites surveyed during the coho salmon season. Surveys of the Point Louisa, Auke Recreational Area, Auke Bay Floats, Auke Creek mouth, and Salmon Creek sites were discontinued after October 22, as the coho fishery was either over by that date or never developed at these locations.

The largest amount of angler effort was generated at the Fish Creek, Gastineau Hatchery, and Mendenhall Ponds areas (Table 6). The largest amount of effort occurred in late September and early October, with the effort at all three of these sites peaking in the biweekly period from 25 September to 8 October. During the biweekly period from 23 October to 5 November, effort declined.

About 722 large coho salmon (SE = 122) and 2,109 jack coho salmon (SE = 364) were taken during the survey period. Additionally, an estimated 19 large coho salmon (SE = 50) were taken at Fish Creek during the period from 31 July to 13 August. The largest numbers of large coho salmon were taken at the Gastineau Hatchery (336) and Sheep Creek (216) sites. No coho salmon were estimated to have been harvested at Auke Recreational Area, Salmon Creek mouth, Auke Bay floats, or Auke Creek mouth.

A total of 420 coho salmon were sampled for missing adipose fins at the roadside sites. Hatchery contributions by tag code at the sites showed that an estimated 91% of the coho salmon harvested at the sites were of hatchery origin (Table 7). Only coho salmon released at Mendenhall Ponds were harvested there, but in the other sport fisheries, fish were recovered from more than one release site. At Fish Creek, 13% of the coho salmon harvested were released at Sheep Creek, Mendenhall Ponds, or Gastineau Hatchery. Fish released at Fish Creek, however, were taken only in the Fish Creek sport fishery. Fish reared at Sheep Creek hatchery but released at either Gastineau Hatchery or Auke Recreational Area often returned to the Sheep Creek hatchery. Of those fish released in 1988, the tag lot (04-30-15) released at the Gastineau Hatchery produced the largest number of large coho salmon for Juneau roadside anglers.

Table 5. Estimates of hatchery produced chinook salmon contributed to Juneau roadside sport fisheries from 19 June to 5 November 1989.

Sport Fishery	Hatchery	Release Site	Tag Code	Recov ^a	Contr ^b	Var. of Contr ^c
Auke Bay Area ^d	Snettisham	Auke Creek	04-26-01	1	5	35
			04-26-03	1	5	30
			04-29-61	1	26	---
		Gastineau Hatch.	04-31-36	1	5	30
		Montana Creek	04-31-58	1	19	---

Fish Creek	Snettisham	Sheep Creek	04-26-06	1	20	620
		Fish Creek	04-26-07	2	54	---
			04-27-42	1	23	578
			04-27-44	2	43	591
			04-30-01	3	83	3,931
TOTAL			14	284	5,816	

^a Recov = Number of fish recovered of noted tag code.

^b Contr = Estimated harvest of the release of the noted tag code.

^c Var. of Contr = Variance of estimated harvest of the release of the noted tag code.

^d Includes sport fisheries at mouth of Auke Creek and at Auke Bay Docks.

Table 6. Effort and harvest statistics for the Juneau roadside coho salmon enhancement surveys by biweekly period and area during 1989.

	Biweekly Period					
	28 Aug. 10 Sept.	11 Sept. 24 Sept.	25 Sept. 08 Oct.	09 Oct. 22 Oct.	23 Oct. 05 Nov.	Total
<u>Effort (Angler-Hours)</u>						
Point Louisa	206	327	15	0	---	548
Auke Recreational Area	0	0	0	0	---	0
Auke Bay Floats	341	150	18	37	---	546
Auke Creek Mouth	125	110	0	0	---	235
Mendenhall Ponds	0	28	375	217	120	740
Salmon Creek	0	74	0	0	---	74
Gastineau Hatchery	17	480	639	63	0	1,199
Sheep Creek	42	95	96	160	75	468
Fish Creek	185	151	783	284	26	1,429
Total	916	1,415	1,926	761	221	5,239
SE	185	199	181	112	36	347

<u>Large Coho Salmon (>16") Kept^a</u>						
Point Louisa	10	25	0	0	0	35
Auke Recreational Area	0	0	0	0	0	0
Auke Bay Floats	0	0	0	0	0	0
Auke Creek Mouth	0	0	0	0	0	0
Mendenhall Ponds	0	0	30	6	31	67
Salmon Creek	0	0	0	0	0	0
Gastineau Hatchery	0	180	149	7	0	336
Sheep Creek	0	5	17	97	97	216
Fish Creek	0	12	10	46	0	68
Total	10	222	206	156	128	722
SE	6	70	73	51	44	122

<u>Jack Coho Salmon (<16") Kept</u>						
Point Louisa	0	0	0	0	0	0
Auke Recreational Area	0	0	0	0	0	0
Auke Bay Floats	0	0	0	0	0	0
Auke Creek Mouth	0	0	0	0	0	0
Mendenhall Ponds	0	0	770	70	19	859
Salmon Creek	0	0	0	0	0	0
Gastineau Hatchery	0	0	28	9	0	37
Sheep Creek	0	9	17	66	2	94
Fish Creek	0	201	799	119	0	1,119
Total	0	210	1,614	264	21	2,109
SE	--	116	323	122	8	364

^a Additional harvest of an estimated 19 large coho salmon occurred at Fish Creek during chinook salmon surveys in the 31 July to 13 August biweek.

Table 7. Recovery and contribution estimates for hatchery coho salmon taken on the Juneau roadside during 1989.^a

Sport Fisheries														
Release Information			Fish Creek		Sheep Creek		Mendenhall Ponds		Gastineau H.		Point Louisa		GRAND TOTAL	
Tag Code	Year	Site	No. of ^b Recov.	Contrib. ^c	No. of ^b Recov.	Contrib. ^c	No. of ^b Recov.	Contrib. ^c	No. of ^b Recov.	Contrib. ^c	No. of ^b Recov.	Contrib. ^c	No. of ^b Recov.	Contrib. ^c
4-27-29	1987	Fish C.	1	12									1	12
4-29-48	1988	Fish C.	5	100									5	100
4-31-53	1989	Fish C.	71	814									71	814
		Subtotal	77	926									77	926
4-29-47	1988	Sheep C.			1	128							1	128
4-31-54	1989	Sheep C.	4	75	5	82			2	22			11	179
		Subtotal	4	75	6	210			2	22			12	307
4-27-30	1987	Mend. Ponds					1	12					1	12
4-29-49	1988	Mend. Ponds					3	39					3	39
4-31-55	1989	Mend. Ponds	7	51			33	783			1	6	41	840
		Subtotal	7	51			37	834			1	6	45	891
4-30-15	1988	Gastineau H.			8	95			15	331			23	426
4-32-31	1989	Gastineau H.	1	6									1	6
		Subtotal	1	6	8	95			15	331			24	432
4-30-14	1988	Auke Rec.			5	22					3	28	8	50
TOTAL HATCHERY			89	1,058	19	327	37	834	17	353	4	34	166	2,606
TOTAL COHO SALMON HARVEST				1,206 ^d		310		926		373		35		2,850 ^d
PERCENT HATCHERY COHO				88%		105%		90%		95%		97%		91%

^a See Appendix A5 for variances.

^b No. of Recov. = Number of fish recovered of noted tag code.

^c Contrib. = Estimated harvest of the release of the noted tag code.

^d Includes 19 large coho caught during the biweek from 31 July to 13 August 1989.

DISCUSSION

Montana Creek Steelhead Fishery

A number of factors probably limited angler effort for steelhead at Montana Creek during 10 April to 4 June 1989. These factors include: limited access to much of Montana Creek, a no bait regulation on the stream, poor catch rates for steelhead, and the fishery was new and not well publicized. Due to the large size of the stream, substantial numbers of steelhead must be present before anglers can effectively target on steelhead. Repeal of the no-bait regulation in the spring might improve steelhead harvest rates without severely impacting wild stocks of trout and char. Catches of Dolly Varden and cutthroat trout *O. clarki* (Appendix A2) and foot surveys of the upper reaches of the stream suggest that the use of Montana Creek by Dolly Varden and cutthroat trout is low during this period.

The "select" steelhead collected during this survey were presumably age 2-ocean fish from the 1987 release of 28,560 Klawock hatchery steelhead which were adipose-clipped and not coded-wire tagged. The 23 inch and 24 inch fork lengths of these two steelhead support a 2-ocean age estimate.

Chinook Salmon Fisheries

Returns of primarily age 2-ocean and 3-ocean chinook salmon to the Juneau enhancement sites generated some roadside sport fishing effort and harvest during 1989. Since most chinook salmon return as age 3-ocean or 4-ocean fish, sport fisheries should be larger in 1990. Anglers may also learn to more effectively target on the returning mature chinook salmon. Boat anglers also fished in the terminal area and these anglers took an estimated 52 small and 49 large chinook salmon (Suchanek and Bingham 1990). The boat anglers, however, did not target effectively on small mature chinook salmon as fish sampled from parties fishing the terminal harvest area were all immature. Shore based anglers, however, caught primarily mature chinook salmon.

Timing of the runs may have been delayed during 1989 due to low water levels. Although no harvest was observed during the 19 June to 2 July biweekly period in 1989, the creel survey should still be conducted during this period in future years in case runs develop early. Straying of the hatchery fish is occurring, but since no wild runs of chinook salmon occur in roadside streams, this straying probably has little effect on wild runs of chinook salmon.

Since chinook salmon have only been released on the Juneau roadside since 1986 in the current enhancement program, a complete evaluation of a given release is not possible. The three years of contribution data that are available, however, do permit an interim evaluation of the 1986 chinook salmon releases. As noted previously, these releases of hatchery chinook salmon contribute to roadside fisheries as well as to boat sport fisheries and commercial fisheries (Table 8). Tag codes that contribute the largest numbers of fish to the sport fisheries also contribute relatively well to commercial fisheries. Direct releases of chinook salmon do not contribute as well per 1,000 smolts released as those in which fish are retained, fed, and imprinted before release. The relatively small contributions are probably due to a decrease in survival rates. For this reason, direct releases of chinook salmon at the Fish and Auke creek sites were discontinued in 1988 and 1989. Since there is no readily available option for

Table 8. Summary of contributions of hatchery chinook salmon for 1986 releases by tag lot on the Juneau roadside to sport and commercial fisheries, 1988-1989.

Release Information					Sport Contributions ^a				Sport Contribution Per 1,000 Smolt Released
Site	Release Strategy ^b	No. ^c (tag lot)	Weight per fish (grams)	Commercial Contribution through 1989 ^d	1988 Boat	1989 Boat	1989 Roadside	Total	
Montana Cr.	DIR	28,335 (4-26-02)	8.4	2	0	0	0	0	0.0
Fish Cr.	DIR	30,620 (4-26-05)	7.5	14	0	0	0	0	0.0
Auke Cr.	DIR	26,896 (4-26-08)	8.0	26	29	22	0	51	1.9
Auke Cr.	RET	29,003 (4-26-01)	9.0	103	26	68	5	99	3.4
Fish Cr.	IMP	29,652 (4-26-07)	8.4	42	29	4	54	87	2.9
Auke Cr.	IMP	29,737 (4-26-03)	9.1	116	45	31	5	81	2.7
Sheep Cr.	IMP	30,280 (4-26-06)	7.7	183	47	64	20	131	4.3
Total					176	189	84	449	2.20
Percent of Total Sport Contribution					39%	42%	19%	100%	

^a Additional sport contribution data taken from Suchanek and Bingham (1989, 1990).

^b DIR = Direct release
RET = Retained and fed
IMP = Retained, fed, and imprinted

^c No. = Number fish released for noted tag lot.

^d Contributions to commercial fisheries obtained from FRED division for years through 1989.

imprinting fish before release into Montana Creek, it is questionable whether chinook salmon should continue to be stocked at this site.

Coho Salmon Fisheries

Juneau roadside anglers benefited greatly in 1989 from coho salmon released during 1988 and 1989. This was in contrast to 1988, when local anglers failed to benefit substantially from 1987 releases of coho salmon (Suchanek and Bingham 1989). Variation in ocean survival apparently has a large effect on the success with which roadside anglers catch hatchery coho salmon. Local releases of hatchery coho salmon contribute to boat sport fisheries as well as to the roadside fisheries (Table 9). Sport contributions from the 1988 releases of coho salmon totaled 743 fish (57%) to the roadside fisheries and 551 fish (43%) to local boat fisheries.

By examining contributions of coho salmon by anglers on a per-smolt-released basis, release sites may be evaluated on their effectiveness for enhancing sport fisheries (Table 9). This type of analysis assumes that the quality of smolts released is equal from year to year and site to site. Smolt size of coho salmon releases, however, have varied greatly in recent years (Table 9). Evaluation of release sites therefore becomes confounded by this variation in smolt quality. Variation in smolt size at release appears to be highly and positively correlated with the contribution of coho salmon to sport fisheries on the Juneau roadside during 1987 and 1988 (Figure 2). Releases of smolts approximately 40 grams in weight in 1989 led to very large returns of jack coho salmon. Cumulative contributions to the sport fishery through November 1989 by the Fish Creek and Mendenhall Ponds releases already total about 20 (2%) per 1,000 smolts released. Continued creel survey evaluations in 1990 are necessary to better assess the value of the release of very large smolts.

Straying occurs with some regularity in local releases of hatchery coho salmon (Table 7). Since local stocks of wild coho salmon may be impacted by this straying, evaluation of this straying by tag lot should continue. Hatchery fish may be harvested at locations other than the release sites, and other roadside sites should also be checked for harvests of hatchery fish. It appears that straying is greatest when coho salmon are taken directly from the rearing hatchery and released in saltwater. This straying could be better controlled by minimizing movements of fish to saltwater release sites.

CONCLUSIONS AND RECOMMENDATIONS

Large changes in southeast Alaska sport fisheries have occurred over the past decade. Wild stocks of fish support most of the sport fisheries, but increasing enhancement efforts have led to increases in the harvests of hatchery chinook and coho salmon. These enhancement efforts can be costly and creel sampling programs are instrumental in evaluating the success of these programs. During 1989, harvest survey programs showed that contributions of hatchery steelhead to local sport fisheries was extremely poor, but that sport fisheries for chinook and coho salmon benefited from local enhancement efforts. Creel surveys of both marine boat and roadside fisheries will continue to be necessary to evaluate and improve the cost effectiveness of stocking programs. These surveys also provide valuable information for public education, proposed regulatory changes, and baseline data on the fisheries. It is recommended that the creel surveys of enhancement sites

Table 9. Summary of contributions of hatchery coho salmon releases by tag lot on the Juneau roadside to local sport fisheries, 1986-1989.^a

Release Information							
Site	No. ^c	(tag lot)	Weight per fish (grams)	Sport Contribution ^b			Contribution Per 1,000 Smolt Released
				Roadside	Boat	Total	
<u>1986</u>							
Salmon Creek	20,422	(4-23-61)	9.4	0	0	0	0.0
<u>1987</u>							
Salmon Creek	101,000	(4-27-28)	3.5	0	0	0	0.0
Fish Creek	53,000	(4-27-29)	7.8	12	0	12	0.2 ^d
Sheep Creek	39,442	(4-28-20)	12.0	0	19	19	0.5
Mendenhall Ponds	53,000	(4-27-30)	3.4	41	12	53	1.0 ^d
<u>1988</u>							
Fish Creek	50,000	(4-29-48)	12.5	100	77	177	3.5
Sheep Creek	100,000	(4-29-47)	10.9	128	165	293	2.9
Mendenhall Ponds	50,000	(4-29-49)	6.8	39	22	61	1.2
Gastineau Hatch.	49,659	(4-30-15)	20.9	426	172	598	12.0
Auke Rec. Area	18,896	(4-30-14)	16.0	50	115	165	8.7
<u>1989</u>							
Fish Creek	42,000	(4-31-53)	39.5	814	9	823	19.6
Sheep Creek	44,940	(4-31-54)	40.2	179	13	192	4.3
Mendenhall Ponds	37,000	(4-31-55)	38.5	840	59	899	24.3
Gastineau Hatch.	36,866	(4-32-31)	19.0	6	0	6	0.2

^a This table does not include releases of coho salmon at Twin Lakes.

^b Sport contribution data taken from Mecum and Suchanek (1987), Bingham, et al. (1988), and Suchanek and Bingham (1989, 1990).

^c No. = Number fish released for noted tag lot.

^d Sport contributions from both of these two releases were due to coho salmon holding over for an additional year before outmigrating in 1988.

Sport Contribution Per 1,000 Coho Salmon Smolt Released on the Juneau Roadside

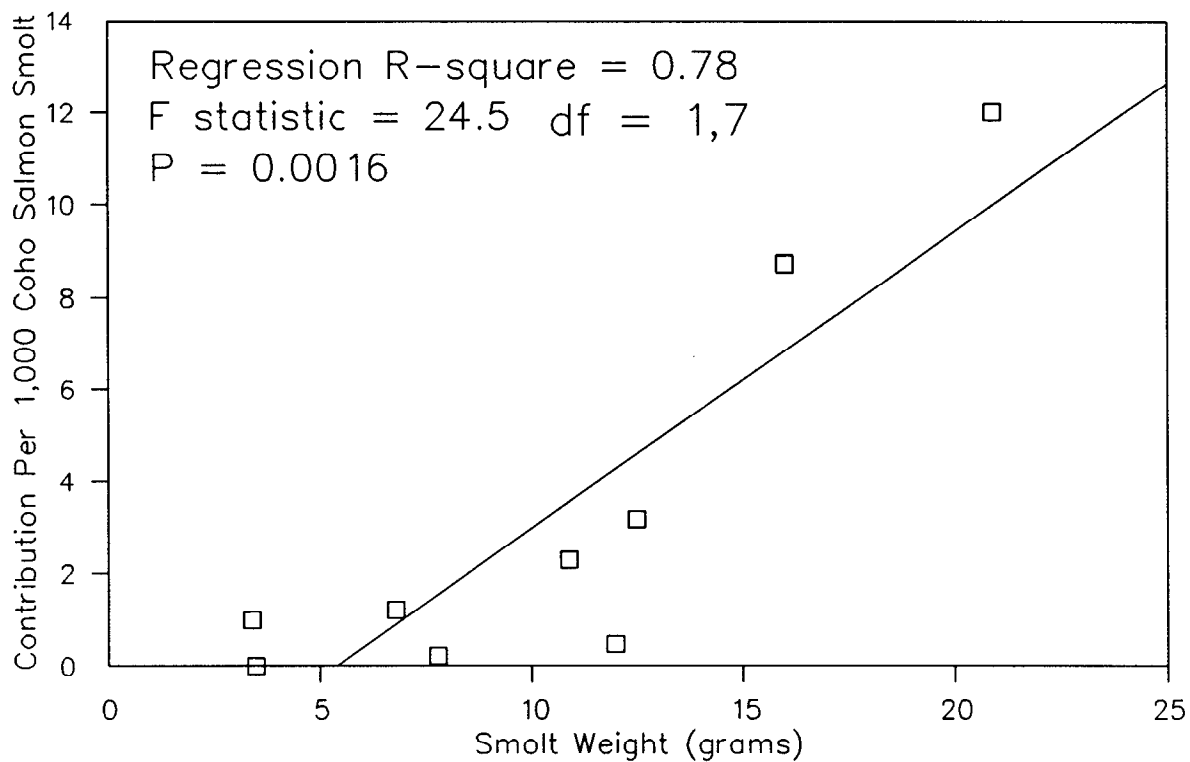


Figure 2. Contributions to sport fisheries per 1,000 smolts released for 1987 and 1988 releases of coho salmon on the Juneau roadside.

be continued in 1990 and, if funding is available, be expanded to other areas where harvests of hatchery fish may be occurring.

ACKNOWLEDGEMENTS

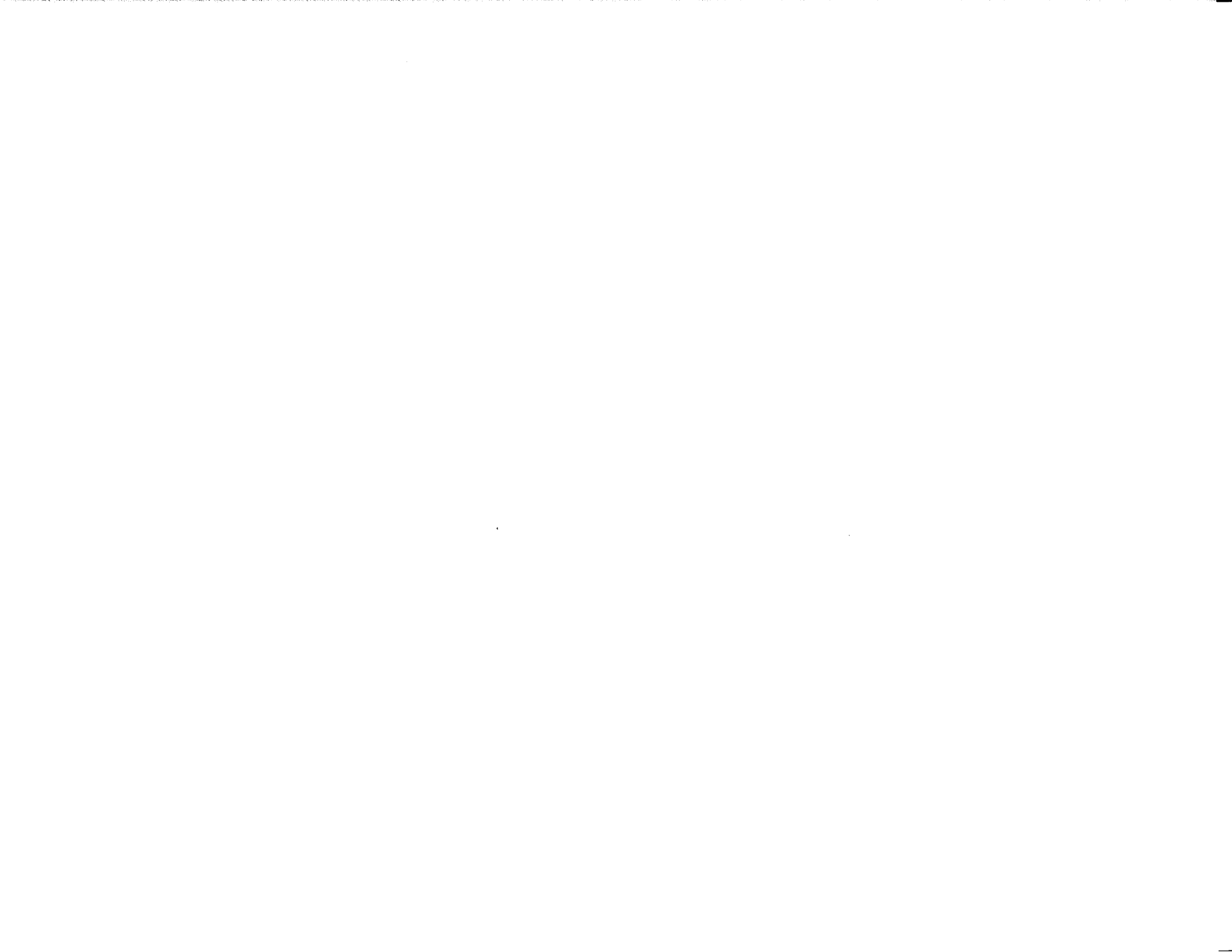
We wish to thank the Juneau roadside creel survey staff of Sue Millard and Mike Jaenicke for their invaluable data collection efforts and suggestions to improve the survey. Mike Bethers also provided input to the study design and has worked to enhance the Juneau roadside fisheries for many years. The ADF&G staff of the Fisheries Rehabilitation, Enhancement, and Development (FRED) Division CWT lab are gratefully acknowledged for their work on dissecting salmon heads, coded-wire tag decoding, and data reduction efforts. We thank Donna Buchholz and Gail Heineman of the Research and Technical Services Unit (RTS) of the Division of Sport Fish for their diligence in mark sense form processing and data control.

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APPENDIX A

Freshwater:

Montana Creek: Flows into the Mendenhall River one mile upstream from the Brotherhood Bridge. This fishery occurs only in freshwater from the mouth to approximately 5 miles upstream. Counts and interviews taken in three areas: lower, middle, and upper. The lower area includes the mouth of the creek and upstream approximately 200 yards and also the area approximately 100 yards downstream in the Mendenhall River. The middle area includes waters 400 yards both upstream and downstream of the Back Loop Road bridge. The upper area is much more dispersed and includes parking areas distributed along the Montana Creek road from approximately "the gorge" to the end of Montana Creek Road (a distance of about three miles).

Mendenhall Ponds: This system of small lakes is located north of the Mendenhall Back Loop Bridge, east of the Mendenhall River, and south of Mendenhall Lake (the ponds drain into the Mendenhall River). Fishing for coho occurs primarily in the holding pond, outlet of holding pond, and in nearby Moose Lake, and these will be the only areas of the system surveyed. This site has been referred to in previous reports as Dredge Lakes.

Fish Creek: Located on Douglas Island and flows into Fritz Cove on north end of island. The fishery partially occurs in saltwater in the channel near the mouth. Most fishing, however, occurs in freshwater in an attached pond and upstream of the mouth to about 100 yards upstream of the North Douglas Highway bridge, a distance of approximately 400 yards.

Saltwater:

Point Louisa: This point is accessible from road in Auke Village Campground at Glacier Highway Mile 14.5. Fishery occurs from rocks for 300 yards along point.

Auke Recreational Area: This saltwater shoreline fishery extended from approximately Glacier Highway Mile 14.0 to near Point Louisa which is accessible from the Auke Village Campground off the Glacier Highway at Mile 14.5.

Auke Bay Floats: Fishery occurs from docks in Auke Bay which include Government Dock, Auke Launch Ramp, and Dehart's Marina.

Auke Creek Mouth: Located at the head of Auke Bay. The fishery at Auke Creek mouth occurs in saltwater near the mouth of the creek as the creek itself is closed to fishing. Shore anglers will be counted on the beach within one-quarter mile of the mouth.

Salmon Creek: Fishery located three miles north of Juneau adjacent to the south end of Twin Lakes and accessible from parking lots on both east and west sides of freeway. Fishery mostly occurs downstream from Egan Expressway bridge where the area is defined as having saltwater regulations.

-(Continued)-

Gastineau Hatchery: This fishery developed for the first time during 1989 at the hatchery located about 3 miles north of Juneau along the Egan Expressway. Anglers fish from just north of the hatchery outfall along the shore several hundred yard to an old barge.

Sheep Creek: Located approximately four miles south of Juneau along Thane Road. This fishery occurs just downstream from the Thane Road bridge and includes only a saltwater area as this creek is closed to salmon fishing. Anglers will be counted and interviewed for about 250 yards north and south of the mouth.

Appendix A2. Effort and harvest statistics for the Montana Creek steelhead enhancement surveys by biweekly period and area during 1989.

	Estimates ^a				
	Biweekly Period				
	10 April 23 April	24 April 07 May	08 May 21 May	22 May 04 June	Total
<u>Montana Creek (Upper)</u>					
Number of Count and Interview Samples	12	12	12	12	48
Number of Possible Samples	210	224	224	238	896
Number of Anglers Interviewed	0	1	4	1	6
Angler-hours effort					
Estimate	0	32	59	0	91
Variance	0	928	1,118	0	2,046
Steelhead Released					
Estimate	---	0	16	0	16
Variance	---	0	113	0	113
<u>Montana Creek (Middle)</u>					
Number of Count and Interview Samples	12	12	12	12	48
Number of Possible Samples	210	224	224	238	896
Number of Anglers Interviewed	0	2	0	0	2
Angler-hours effort					
Estimate	0	27	0	0	27
Variance	0	684	0	0	684
<u>Montana Creek (Lower)</u>					
Number of Count and Interview Samples	12	12	12	12	48
Number of Possible Samples	210	224	224	238	896
Number of Anglers Interviewed	2	6	4	6	18
Angler-hours effort					
Estimate	20	48	53	24	146
Variance	144	1,097	2,738	541	4,520
Dolly Varden Released					
Estimate	0	0	0	23	23
Variance	0	0	0	499	499
Cutthroat Kept					
Estimate	0	0	0	8	8
Variance	0	0	0	55	55

^a If no harvested or released steelhead, Dolly Varden, cutthroat, or salmon of a given species and size class were observed, then these categories of zero catch were excluded from the table for each area.

Appendix A3. Effort and harvest statistics for the chinook salmon enhancement surveys by biweekly period and area during 1989.

	Estimates ^a					
	Biweekly Period					
	19 June 02 July	03 July 16 July	17 July 30 July	31 July 13 Aug.	14 Aug. 27 Aug.	Total
<u>Auke Bay Floats</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	70	47	10	19	48	194
Angler-hours effort						
Estimate	1,830	791	235	384	1,042	4,282
Variance	1,881,503	72,605	8,159	32,421	136,362	2,131,050
Small (<28") Chinook Salmon Kept						
Estimate	0	16	0	0	0	16
Variance	0	140	0	0	0	140
Small (<28") Chinook Salmon Released						
Estimate	0	0	0	0	36	36
Variance	0	0	0	0	370	370
Pink Salmon Kept						
Estimate	0	81	0	0	0	81
Variance	0	3,395	0	0	0	3,395
Pink Salmon Released						
Estimate	0	0	0	183	0	183
Variance	0	0	0	21,752	0	21,752
Dolly Varden Kept						
Estimate	74	0	0	0	0	74
Variance	3,450	0	0	0	0	3,450
Dolly Varden Released						
Estimate	162	16	0	0	0	178
Variance	13,866	140	0	0	0	14,007
<u>Auke Creek Mouth</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	9	10	28	0	10	57
Angler-hours effort						
Estimate	170	142	336	0	173	821
Variance	4,058	6,118	15,367	0	11,352	36,895
Small (<28") Chinook Salmon Kept						
Estimate	0	0	13	---	0	13
Variance	0	0	324	---	0	324
Pink Salmon Kept						
Estimate	0	11	140	---	0	152
Variance	0	68	4,306	---	0	4,374
Pink Salmon Released						
Estimate	0	11	78	---	27	117
Variance	0	68	11,675	---	698	12,441
Chum Salmon Released						
Estimate	0	0	0	---	34	34
Variance	0	0	0	---	1,090	1,090
Dolly Varden Kept						
Estimate	13	0	13	---	0	26
Variance	211	0	69	---	0	280
Dolly Varden Released						
Estimate	0	11	0	---	0	11
Variance	0	67	0	---	0	67

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Appendix A3. (page 2 of 4)

	Estimates ^a					
	Biweekly Period					
	19 June 02 July	03 July 16 July	17 July 30 July	31 July 13 Aug.	14 Aug. 27 Aug.	Total
<u>Montana Creek - Upper</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	4	21	12	6	8	51
Angler-hours effort						
Estimate	57	85	181	128	147	598
Variance	3,098	4,477	5,473	7,872	5,622	26,542
Pink Salmon Released						
Estimate	0	0	8	0	0	8
Variance	0	0	62	0	0	62
Chum Salmon Kept						
Estimate	0	4	34	0	0	38
Variance	0	13	708	0	0	720
Chum Salmon Released						
Estimate	0	4	34	0	0	38
Variance	0	13	708	0	0	720
Dolly Varden Kept						
Estimate	0	17	8	0	88	113
Variance	0	247	62	0	2,390	2,699
Dolly Varden Released						
Estimate	0	17	127	105	419	668
Variance	0	200	6,841	6,174	56,284	69,500
Cutthroat Released						
Estimate	0	0	0	16	0	16
Variance	0	0	0	248	0	248
<u>Montana Creek - Middle</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	1	3	9	4	1	18
Angler-hours effort						
Estimate	0	57	69	107	0	233
Variance	0	1,194	2,334	5,703	0	9,231
Pink Salmon Released						
Estimate	0	0	0	32	0	32
Variance	0	0	0	992	0	992
Dolly Varden Kept						
Estimate	0	19	5	0	0	24
Variance	0	149	20	0	0	168
Dolly Varden Released						
Estimate	0	19	9	85	0	113
Variance	0	149	78	6,940	0	7,167

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Appendix A3. (page 3 of 4)

	Estimates ^a					Total
	Biweekly Period					
	19 June 02 July	03 July 16 July	17 July 30 July	31 July 13 Aug.	14 Aug. 27 Aug.	
<u>Montana Creek - Lower</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	11	16	8	0	4	39
Angler-hours effort						
Estimate	261	213	80	0	24	577
Variance	22,738	8,841	2,272	0	528	34,380
Pink Salmon Kept						
Estimate	0	6	7	---	48	61
Variance	0	22	45	---	2,115	2,182
Pink Salmon Released						
Estimate	0	6	7	---	0	13
Variance	0	22	43	---	0	65
Chum Salmon Kept						
Estimate	0	18	0	---	0	18
Variance	0	108	0	---	0	108
Chum Salmon Released						
Estimate	0	18	13	---	0	32
Variance	0	139	172	---	0	311
Dolly Varden Kept						
Estimate	45	6	20	---	0	71
Variance	973	39	234	---	0	1,247
Dolly Varden Released						
Estimate	0	0	27	---	0	27
Variance	0	0	293	---	0	293
<u>Sheep Creek</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	49	147	164	87	26	473
Angler-hours effort						
Estimate	918	2,553	2,736	2,048	456	8,711
Variance	42,644	225,710	346,863	351,472	24,438	991,127
Pink Salmon Kept						
Estimate	6	354	1,306	1,250	500	3,415
Variance	212	20,841	178,328	248,391	32,445	480,217
Pink Salmon Released						
Estimate	0	78	203	1,557	262	2,100
Variance	0	4,881	10,915	3,847,869	12,374	3,876,039
Chum Salmon Kept						
Estimate	0	80	328	312	0	721
Variance	0	782	18,648	13,925	0	33,355
Chum Salmon Released						
Estimate	0	210	406	509	237	1,363
Variance	0	4,744	44,997	109,044	10,580	169,366
Dolly Varden Kept						
Estimate	36	156	209	184	21	606
Variance	192	6,305	15,130	9,309	275	31,212
Dolly Varden Released						
Estimate	100	42	125	115	0	381
Variance	10,947	1,745	3,109	2,863	0	18,665

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Appendix A3. (page 4 of 4)

	Estimates ^a					
	Biweekly Period					
	19 June 02 July	03 July 16 July	17 July 30 July	31 July 13 Aug.	14 Aug. 27 Aug.	Total
<u>Fish Creek</u>						
Number of Count and Interview Samples	12	12	12	8	11	55
Number of Possible Samples	238	238	224	224	210	1,134
Number of Anglers Interviewed	14	24	22	28	33	121
Angler-hours effort						
Estimate	210	272	187	672	426	1,766
Variance	6,849	12,213	5,267	48,853	27,108	100,290
Large (>28") Chinook Salmon Kept						
Estimate	0	0	0	57	8	65
Variance	0	0	0	1,606	29	1,635
Small (<28") Chinook Salmon Kept						
Estimate	0	0	3	152	16	170
Variance	0	0	5	8,799	173	8,975
Small (<28") Chinook Salmon Released						
Estimate	0	0	0	117	40	157
Variance	0	0	0	1,354	1,061	2,415
Large (>16") Coho Salmon Kept						
Estimate	0	0	0	19	0	19
Variance	0	0	0	2,500	0	2,500
Pink Salmon Kept						
Estimate	0	17	13	331	97	458
Variance	0	145	55	9,576	3,171	12,947
Pink Salmon Released						
Estimate	0	64	16	826	600	1,506
Variance	0	1,557	132	87,341	68,972	158,002
Chum Salmon Kept						
Estimate	0	0	8	0	0	8
Variance	0	0	199	0	0	199
Chum Salmon Released						
Estimate	0	6	8	0	16	30
Variance	0	13	484	0	174	670
Dolly Varden Kept						
Estimate	37	41	11	0	137	226
Variance	587	734	109	0	7,926	9,356
Dolly Varden Released						
Estimate	57	12	80	19	32	200
Variance	892	2,864	6,137	207	453	10,552
Cutthroat Kept						
Estimate	0	18	0	0	0	18
Variance	0	176	0	0	0	176

^a If no harvested or released steelhead, Dolly Varden, cutthroat, or salmon of a given species and size class were observed, then these categories of zero catch were excluded from the table for each area.

Appendix A4. Effort and harvest statistics for the coho salmon enhancement surveys by biweek and area during 1989.

	Estimates ^a				
	Biweekly Period				
	28 Aug. 10 Aug.	11 Sept. 24 Sept.	25 Sept. 08 Oct.	09 Oct. 22 Oct.	Total
<u>Point Louisa</u>					
Number of Count and Interview Samples	14	15	16	16	61
Number of Possible Samples	210	196	168	154	728
Number of Anglers Interviewed	22	36	4	0	62
Angler-hours effort					
Estimate	206	327	15	0	548
Variance	7,831	4,439	210	0	12,480
Large (>16") Coho Salmon Kept					
Estimate	10	25	0	---	36
Variance	38	116	0	---	154
Large (>16") Coho Salmon Released					
Estimate	0	4	0	---	4
Variance	0	5	0	---	5
<u>Auke Recreational Area</u>					
Number of Count and Interview Samples	14	15	16	16	61
Number of Possible Samples	210	196	168	154	728
Number of Anglers Interviewed	0	0	0	0	0
Angler-hours effort					
Estimate	0	0	0	0	0
Variance	0	0	0	0	0
<u>Auke Bay Floats</u>					
Number of Count and Interview Samples	14	15	16	16	61
Number of Possible Samples	210	196	168	154	728
Number of Anglers Interviewed	38	13	2	7	60
Angler-hours effort					
Estimate	341	150	18	37	546
Variance	9,498	7,496	64	773	17,831
Large (>28") Chinook Salmon Kept					
Estimate	9	0	0	0	9
Variance	45	0	0	0	45
Small (<28") Chinook Salmon Kept					
Estimate	9	0	0	0	9
Variance	45	0	0	0	45
Pink Salmon Kept					
Estimate	118	0	0	0	118
Variance	5,103	0	0	0	5,103
Pink Salmon Released					
Estimate	27	0	0	0	27
Variance	293	0	0	0	293

-(Continued)-

Appendix A4. (page 2 of 4)

	Estimates ^a					
	Biweekly Period					
	28 Aug. 10 Sept.	11 Sept. 24 Sept.	25 Sept. 08 Oct.	09 Oct. 22 Oct.	23 Oct. 05 Nov.	Total
<u>Auke Creek Mouth</u>						
Number of Count and Interview Samples	14	15	16	16	0	61
Number of Possible Samples	210	196	168	154	0	728
Number of Anglers Interviewed	11	13	0	0	0	24
Angler-hours effort						
Estimate	125	110	0	0	---	235
Variance	10,175	3,128	0	0	---	13,303
Small (<28") Chinook Salmon Kept						
Estimate	0	18	---	---	---	18
Variance	0	188	---	---	---	188
Pink Salmon Kept						
Estimate	20	178	---	---	---	197
Variance	1,479	24,588	---	---	---	26,068
Pink Salmon Released						
Estimate	20	0	---	---	---	20
Variance	1,423	0	---	---	---	1,423
<u>Mendenhall Ponds</u>						
Number of Count and Interview Samples	14	15	16	16	15	76
Number of Possible Samples	210	196	168	154	126	854
Number of Anglers Interviewed	0	3	45	33	23	104
Angler-hours effort						
Estimate	0	28	375	217	120	740
Variance	0	672	5,794	1,717	684	8,867
Large (>16") Coho Salmon Kept						
Estimate	---	0	30	6	31	67
Variance	---	0	3,554	28	143	3,725
Large (>16") Coho Salmon Released						
Estimate	---	0	0	30	12	42
Variance	---	0	0	431	26	457
Dolly Varden Kept						
Estimate	---	0	77	5	0	81
Variance	---	0	1,401	42	0	1,443
Dolly Varden Released						
Estimate	---	0	17	5	4	26
Variance	---	0	713	36	42	792
Jack (<16") Coho Salmon Kept						
Estimate	---	0	770	70	19	859
Variance	---	0	57,524	460	61	58,045
Jack (<16") Coho Salmon Released						
Estimate	---	0	22	60	23	106
Variance	---	0	284	769	1,500	2,554

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Appendix A4. (page 3 of 4)

	Estimates ^a					
	Biweekly Period					
	28 Aug. 10 Sept.	11 Sept. 24 Sept.	25 Sept. 08 Oct.	09 Oct. 22 Oct.	23 Oct. 05 Nov.	Total
<u>Salmon Creek</u>						
Number of Count and Interview Samples	14	15	16	16	0	61
Number of Possible Samples	210	196	168	154	0	728
Number of Anglers Interviewed	0	6	0	0	0	6
Angler-hours effort						
Estimate	0	74	0	0	---	74
Variance	0	3,588	0	0	---	3,588
Pink Salmon Kept						
Estimate	---	37	---	---	---	37
Variance	---	1,295	---	---	---	1,295
<u>Gastineau Hatchery</u>						
Number of Count and Interview Samples	14	15	16	16	15	76
Number of Possible Samples	210	196	168	154	126	854
Number of Anglers Interviewed	2	49	60	5	0	116
Angler-hours effort						
Estimate	17	480	639	63	0	1,198
Variance	107	14,732	6,720	1,270	0	22,829
Large (>16") Coho Salmon Kept						
Estimate	0	180	149	7	---	336
Variance	0	4,694	1,574	12	---	6,280
Large (>16") Coho Salmon Released						
Estimate	0	43	0	0	---	43
Variance	0	362	0	0	---	362
Dolly Varden Kept						
Estimate	0	3	0	0	---	3
Variance	0	8	0	0	---	8
Jack (<16") Coho Salmon Kept						
Estimate	0	0	28	9	---	37
Variance	0	0	206	32	---	238
Jack (<16") Coho Salmon Released						
Estimate	0	17	35	0	---	52
Variance	0	241	302	0	---	543
<u>Sheep Creek</u>						
Number of Count and Interview Samples	14	15	16	16	15	76
Number of Possible Samples	210	196	168	154	126	854
Number of Anglers Interviewed	3	11	8	22	12	56
Angler-hours effort						
Estimate	42	95	96	160	75	467
Variance	703	2,121	2,310	3,605	413	9,152
Large (>16") Coho Salmon Kept						
Estimate	0	5	17	97	97	216
Variance	0	9	110	2,017	1,756	3,893
Large (>16") Coho Salmon Released						
Estimate	0	0	0	37	5	42
Variance	0	0	0	622	10	633
Jack (<16") Coho Salmon Kept						
Estimate	0	9	17	66	2	95
Variance	0	38	228	1,329	4	1,598
Jack (<16") Coho Salmon Released						
Estimate	0	0	69	0	2	71
Variance	0	0	1,766	0	3	1,769

-(Continued)-

	Estimates ^a					
	Biweekly Period					
	28 Aug. 10 Sept.	11 Sept. 24 Sept.	25 Sept. 08 Oct.	09 Oct. 22 Oct.	23 Oct. 05 Nov.	Total
<u>Fish Creek</u>						
Number of Count and Interview Samples	14	15	16	16	15	76
Number of Possible Samples	210	196	168	154	126	854
Number of Anglers Interviewed	18	29	98	43	4	192
Angler-hours effort						
Estimate	185	151	783	284	26	1,430
Variance	5,815	3,561	17,764	5,114	222	32,477
Large (>28") Chinook Salmon Kept						
Estimate	45	0	0	0	0	45
Variance	2,758	0	0	0	0	2,758
Large (>16") Coho Salmon Kept						
Estimate	0	12	10	46	0	68
Variance	0	100	201	812	0	769
Large (>16") Coho Salmon Released						
Estimate	0	0	0	4	0	4
Variance	0	0	0	10	0	10
Pink Salmon Released						
Estimate	90	0	0	0	0	90
Variance	3,522	0	0	0	0	3,522
Dolly Varden Kept						
Estimate	0	22	19	14	0	55
Variance	0	417	116	139	0	672
Dolly Varden Released						
Estimate	0	0	14	14	0	28
Variance	0	0	94	71	0	165
Cutthroat Kept						
Estimate	0	6	0	23	0	29
Variance	0	168	0	179	0	347
Jack (<16") Coho Salmon Kept						
Estimate	0	201	799	119	0	1,119
Variance	0	13,438	46,059	13,128	0	72,625
Jack (<16") Coho Salmon Released						
Estimate	0	0	128	19	8	155
Variance	0	0	1,985	81	72	2,138

^a If no harvested or released steelhead, Dolly Varden, cutthroat, or salmon of a given species and size class were observed, then these categories of zero catch were excluded from the table for each area.

Appendix A5.

Estimates of hatchery produced coho salmon
contributed to Juneau roadside sport
fisheries from 19 June to 5 November 1989.

Sport Fishery	Hatchery	Release Site	Tag Code	Recov ^a	Contr ^b	Var. of Contr ^c
Point Louisa	Sheep Creek	Auke Rec.	04-30-14	3	28	29
	Snettisham	Mendenhall P.	04-31-55	1	6	42
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Mendenhall Ponds	Snettisham	Mendenhall P.	04-27-30	1	12	129
			04-29-49	3	39	492
			04-31-55	33	783	63,724
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Gastineau Hatchery	Sheep Creek	Gastineau H.	04-30-15	15	331	15,398
	Snettisham	Sheep C.	04-31-54	2	22	233
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Sheep Creek	Sheep Creek	Auke Rec.	04-30-14	5	22	118
		Gastineau H.	04-30-15	8	95	1,634
	Snettisham	Sheep C.	04-29-47	1	128	---
			04-31-54	5	82	2,378
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Fish Creek	Gastineau	Gastineau H.	04-32-31	1	6	31
	Snettisham	Fish C.	04-27-29	1	12	162
			04-29-48	5	100	2,511
			04-31-53	71	814	47,931
			Sheep C.	04-31-54	4	75
	Mendenhall P.	04-31-55	7	51	407	
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TOTAL				166	2,606	136,972

^a Recov = Number of fish recovered of noted tag code.

^b Contr = Estimated harvest of the release of the noted tag code.

^c Var. of Contr = Variance of estimated harvest of the release of the noted tag code.

